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AGRICULTURAL MEMORANDUM NO 559

Solar Radiation at Cambridge - Part I

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As there is a current interest at Cambridge in solar radiation, with particular regard to plant physiology, it was decided to examine the possibility of 'up dating' information on obtaining radiation estimates from standard meteorological measurements. This paper deals with the problem on a monthly average basis. Currently the possibility of estimating values for shorter periods is being investigated.

It was decided, after consideration, to work with the radiation data for the 15 years, 1957 to 1971 for Cambridge (recording ceased December 1971). Other Stations (fig 2), on the western periphery of East Anglia, were thought to be not representative or had been recording for too short a time.

Day, in 1961 using the Cambridge data for 1957-1959, produced a constant and coefficient of

$$a = 0.12 \text{ and } b = 0.75 \text{ (correlation coefficient = 0.99)}$$

in the Angstrom equation $Q = Q_A (a + b\, n/N)$
where Q_A = that radiation which could be received on a horizontal surface at the station through a transparent atmosphere
n = hours of bright sunshine
N = Day length

L P Smith, using Cambridge records for the period 1957-1964, found the constant and coefficient to be

$$a = 0.16 \text{ and } b = 0.62$$

Following on in a like manner, but using all the radiation data available for Cambridge (1957-1971) a linear regression equation was computed giving values of

$$a = 0.16 \text{ and } b = 0.64 \text{ with a correlation coefficient of } 0.94$$

Plotting all values of Q/Q_A against n/N and fitting the line $Q = Q_A (0.16 + 0.64\, n/N)$ (fig. 1) showed poor distribution for low and high values of n/N. A non-linear equation was computed, this gave

$Q = Q_A \left[0.12 + 0.89\, n/N - 0.38\, (n/N)^2 \right]$ and showed a marked improvement at the extremes (fig. 1).

The latest linear equation differs very little to the 1965 equation of L P Smith. The disagreement of these two with the 1961 version of Day's would perhaps point to it being too small a sample to be representative. It would seem that better results for values of $^{n}/_{N} < 0.15$ and > 0.45 can be obtained using the non-linear equation, otherwise there is little to choose between the two.

REFERENCES

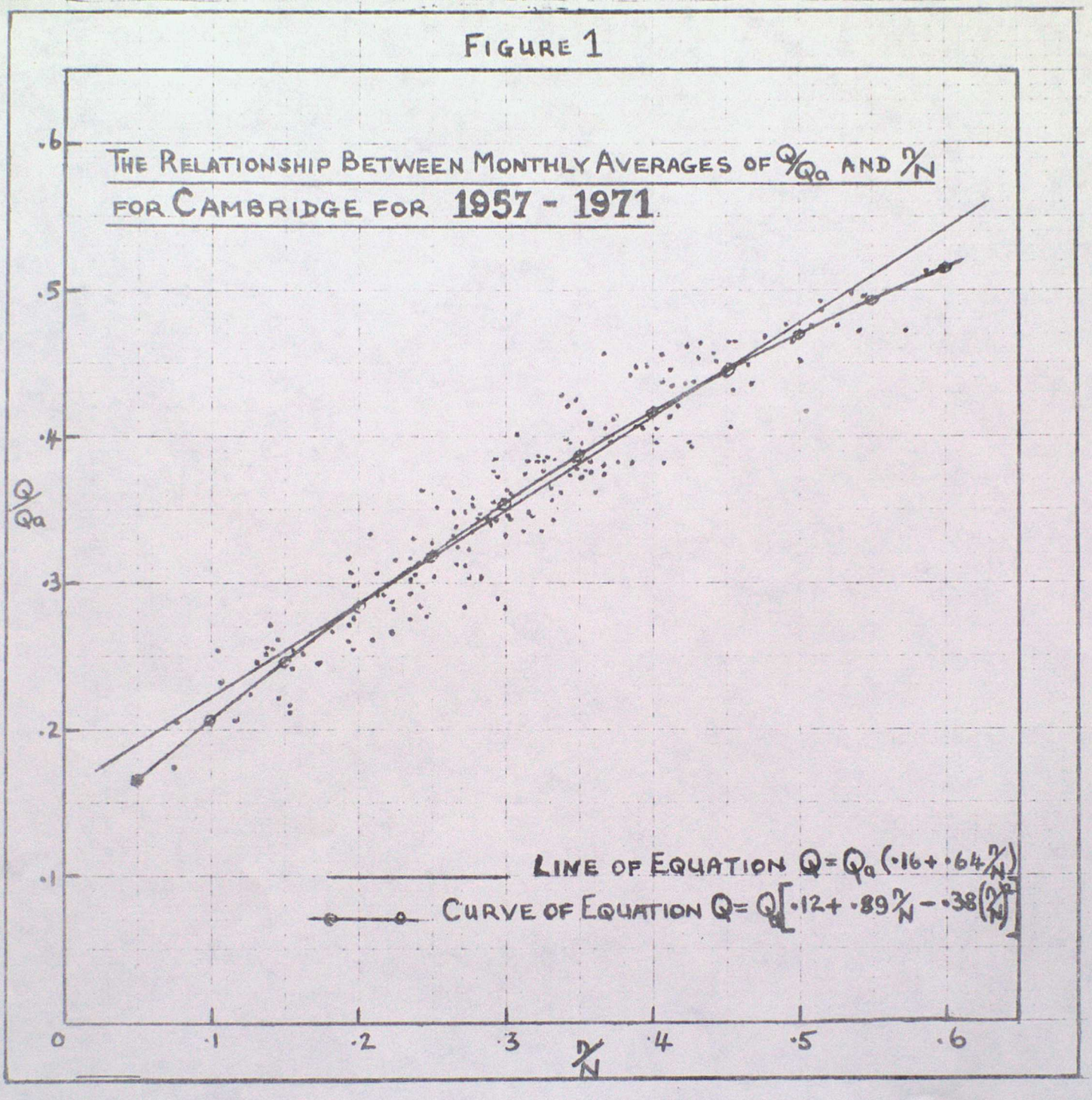
1. ÅNGSTRÖM, A ; On radiation and climate. Geogr. Ann., Stockholm, 1925

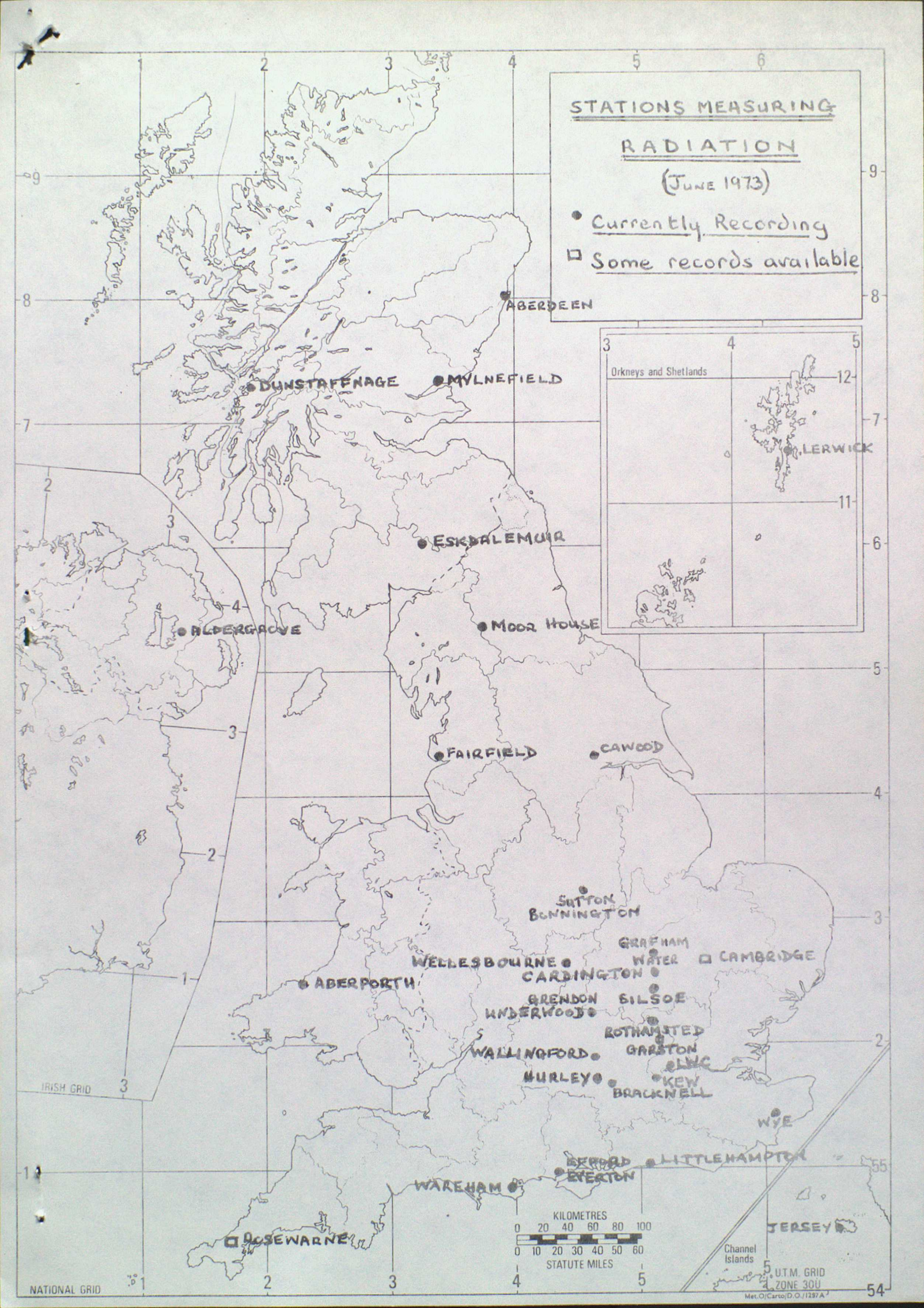
2. DAY, G J ; Distribution of Total Solar Radiation on a horizontal surface over The British Isles and adjacent areas. Met. Mag., No 107, Vol 90, Oct 1961

3. SMITH, L P ; Sunshine Hours and Radiation Ag. Memo 132, Sept. 1965

June 1973
Meteorological Office
Cambridge

FIGURE 1


THE RELATIONSHIP BETWEEN MONTHLY AVERAGES OF Q/Qa AND r/N
FOR CAMBRIDGE FOR 1957 - 1971
.6
.5
.4
.3
.2
.1
Q/Qa
0
.1
.2
.3
.4
.5
.6
r/N
LINE OF EQUATION Q = Qa (.16 + .64 r/N)
CURVE OF EQUATION Q = Qa [.12 + .89 r/N − .38 (r/N)²]


STATIONS MEASURING
RADIATION
(JUNE 1973)
Currently Recording
Some records available
ABERDEEN
DUNSTAFFNAGE
MYLNEFIELD
ESKDALEMUIR
ALDERGROVE
MOOR HOUSE
FAIRFIELD
CAWOOD
SUTTON BONNINGTON
GRAFHAM WATER
CAMBRIDGE
WELLESBOURNE
CARDINGTON
ABERPORTH
BRENDON
SILSOE
UNDERWOOD
ROTHAMSTED
WALLINGFORD
GARSTON
MURLEY
KEW
BRACKNELL
WYE
LITTLEHAMPTON
EVERTON
WAREHAM
ROSEWARNE
JERSEY
Orkneys and Shetlands
LERWICK
IRISH GRID
NATIONAL GRID
KILOMETRES
0 20 40 60 80 100
0 10 20 30 40 50 60
STATUTE MILES
Channel Islands
U.T.M. GRID ZONE 30U
Met.O(Carto)D.O./1297A